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# Summary of NRC Activities to Modernize the Digital I&C Regulatory Infrastructure

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# Presenter Biography

David L. Rahn, P.E.

- Sr. Electronics Engineer, Instrumentation and Controls Branch, Division of Engineering, Office of NRR
- 37 years experience in the nuclear power generation field—design, construction, start-up, maintenance, modifications, licensing, fuel cycle, high-level waste repos.
- Currently responsible for evaluating license applications and amendments; also, updating regulatory infrastructure
- 10yrs--USNRC; 15yrs--Signals & Safeguards, Inc.; 10yrs--Sargent & Lundy/INPO; 2yrs--J&L Engineering (mfr's rep)
- BSEE, MBA, P.E. (Maryland-active & Illinois-inactive)
- Member, IEEE (46 years); ISA-POWID; ANS—NPIC



# Industry Indicates it is Seeking:

- An updated regulatory infrastructure that:
  - Improves efficiency
  - Focuses on basic tenets of sound I&C design principles
  - Addresses industry's issues
    - Too much and unnecessary submittal information (License applications and amendments)
    - Licensing should be scalable and tailorable rather than one-size-fits-all
    - Review of Factory Acceptance Test results should be an inspection activity (not part of the licensing process)
    - Inspection guidance should eliminate inconsistencies and build industry confidence
  - Is an enabler for advancing digital technology in domestic nuclear power plants

# Recent USNRC DI&C Licensing and Infrastructure Activities

## Recently Approved Systems/Platforms

- Diablo Canyon RPS/ESFAS Actuation
- Lockheed Martin NuPAC platform (topical report)
- NuScale Highly Integrated Protection System platform (topical report)
- Grand Gulf, Columbia, Peach Bottom (& others) NUMAC PRNMS/OPMRS

## Critical Documents

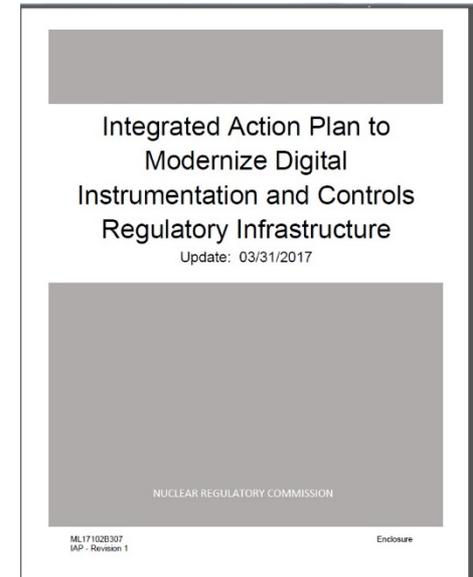
- RIS 2016-05 issued to address embedded digital devices
- Draft RG DG-1292 issued to address dedication of commercial grade items
- RIS 2002-22 Supplement developed to clarify staff endorsement of NEI 01-01

## Under Review

- NEI 16-16 (Guidance for Addressing CCF)
- NEI 96-07 Appendix D (50.59)
- Hope Creek NUMAC PRNMS LAR
- MIT RPS LAR
- Purdue RPS LAR
- Toshiba FPGA Platform
- Mitsubishi Meltac Platform
- Doosan HF Controls Platform
- RadICS Platform
- KHNP APR-1400 Design Certification (DCD)
- NuScale Small Modular Reactor DCD
- Multiple Westinghouse AP-1000 LARs

# Integrated Action Plan

- Primary Focus is on Safety
- March 2016 – SRM-SECY-15-0106 Commission direction to develop an Integrated Action Plan (IAP)
- Frequent interactions with stakeholders
- May 2016 - SECY-16-0070 provided IAP to Commission
- March 2017 – IAP Revision 1 published



# Integrated Action Plan

- Improve clarity and efficiency of licensing and inspection for digital instrumentation and control (DI&C) equipment
- Improve the regulatory infrastructure for DI&C
- Consider the broad context of DI&C regulatory challenges
- Three key topics that have substantial impact, in the near-term: Addressing CCF, Plant Upgrades under 10 CFR 50.59, and Commercial Grade Dedication guidance
- Long-term regulatory infrastructure improvements to address regulatory challenges

# Modernization Plans (MP)

- MP #1 - Protection Against Common Cause Failures (CCF)
- MP #2 - Considering DI&C in accordance with 10 CFR 50.59
- MP #3 - Acceptance of Digital Equipment
- MP #4 - Assessment for Modernization of the I&C Regulatory

# MP #1 - Protection Against Common Cause Failure (CCF)

- The objectives are to:
  - Evaluate the current NRC position using best science and experience
  - Provide clear and effective guidance to licensees to determine the potential for CCF in DI&C, and to address it appropriately
  - Address upgrades under both license amendment request and 10 CFR 50.59
- To achieve this objective, the NRC staff will:
  - Develop a technical basis to support regulatory decisionmaking
  - Consult with external technical experts
  - Engage stakeholders, including industry, through workshops and public meetings
  - Inform and engage the Commission

# MP #1 - Protection Against Common Cause Failure (CCF)

- Key technical issues identified to date include:
  - Need to clarify the appropriate scope of evaluation
    - Software design errors or a broader approach to digital failures
    - Design attributes or development aspects that need to be evaluated
    - Use of a possible graded approach
  - Design Attributes to Eliminate Further CCF Consideration
  - Use of other analysis to demonstrate that CCF is bounded
  - Consequence-based approach for addressing CCFs
  - Best use of risk information
  - Licensing Aspects: LAR vs. 10 CFR 50.59

# MP #1 - Protection Against Common Cause Failure (CCF)

- Initially the focus was on updating or affirming the general policy, but this changed to first focusing on implementable changes
- MP #1A - Guidance on low risk significant systems under 10 CFR 50.59
- MP #1B - Evaluating NEI 16-16 for assessing CCF under current position (LAR or 50.59)
- MP #1C - Evaluating the need to modify NRC position

# MP #1A - Objectives

- Regulatory Issue Summary (RIS) that supplements the staff's previous endorsement of NEI 01-01
- Supporting the upgrade of lower risk-significant digital upgrades under 10 CFR 50.59
- Focus on qualitative assessment using design attributes, quality measures, operating history, and appropriate coping and bounding analyses to address CCF
- Technical evaluation process guidance for use by HQ staff, regional inspectors, and licensees

# RIS 2022-22 Supplement

- Clarifies staff endorsement of NEI 01-01 for 50.59 digital upgrades
- Use of Qualitative Assessments to support basis for 50.59 evaluation criteria
- Applicable to digital upgrades that don't:
  - Reduce independence or diversity
  - Add shared resources where failures could propagate
  - Combine functions not previously combined (e.g., more than one system)
  - Require modification of design basis from new types of failures

# MP #1A - Progress

- Public interactions started in March 2017
- Draft RIS that clarifies:
  - Characteristics of proposed upgrades that would have the highest likelihood of success under 10 CFR 50.59 evaluation process
  - Process and strategy for performing and documenting Qualitative Assessments to serve as adequate technical basis for addressing 10 CFR 50.59 questions
- Draft Qualitative Assessment Framework
- Strategy for developing arguments for responding to the 50.59 criteria, with the support of an adequate qualitative technical basis
- Scheduled for Release by July 7, 2017 for 30-day Public Comment Period

# MP #1B - Objectives and Progress

- Evaluate Industry's proposed guidance in NEI 16-16 for preventing, limiting, or mitigating common cause failures in digital systems for use in nuclear power plants.
- December 2016 - NEI 16-16 [Draft 1] submitted
  - Early draft intended to give staff an idea of framework and structure of the document
  - Multiple stakeholder interactions, NRC comments
- April 2017 – NRC and NEI met to preview content to be included in Appendix A of NEI 16-16 [Draft 2]
- May 2017 – NEI provided NEI 16-16 [Draft 2] with Appendix A included
- June 2017 - Staff comments on NEI 16-16 are now being discussed internally.



## **MP #2 - Evaluating DI&C Upgrades in accordance with 10 CFR 50.59**

- Response to inspection experience and NRC concerns on NEI 01-01
- Industry task force with input from NRC staff found that additional guidance was needed
- General agreement to provide separate technical guidance and create Appendix D to NEI 96-07 to address only the licensing guidance aspects
- NEI intent to request endorsement of final version of NEI 96-07, Appendix D in a new regulatory guide



# MP #2 - Progress

- NRC received draft Appendix D in April 2016
- NRC provided comments in August 2016
- NRC now reviewing and commenting on updated draft by sections
  - Definitions
  - Introduction
  - Screening
  - Evaluation
- NRC decision on issuing interim endorsement
- Need for mapping of definitions and thresholds of Appendix D with those of NEI 16-16



# MP #2 - Initial Observations

- Potential challenges to endorsement
  - New terminology
  - Inconsistency of terminology among Appendix D, current staff positions, and draft NEI 16-16
  - Reference to implementing technical guidance
- May need to resolve technical issues, such as CCF, before full benefit is realized



## MP #3 - Acceptance of Digital Equipment

- Improvements to regulatory infrastructure for acceptance of commercial grade digital equipment for safety applications
- RIS 2016-05 issued to address embedded digital devices
- Draft RG DG-1292 issued that address dedication of commercial grade items
- EPRI researching use of SIL-certified digital equipment in safety applications—determining what are the added value benefits for nuclear power applications



# MP #4 - Assessment for Modernization of the I&C Regulatory Infrastructure

- Modernize the digital I&C regulatory infrastructure to enhance the NRC's capability to be more timely, efficient and effective in ensuring safety, and provide a consistent and predictable regulatory process
- MP #4A [Tactical Modernization] - Building upon first three MPs to provide needed additional regulatory guidance
- MP #4B [Strategic Modernization] - Assess and implement broader modernization of regulatory infrastructure



# MP #4A - Tactical Modernization

- Address impediments to digital modifications of greatest near-term benefit:
  - Build upon MP #1-3 activities  
(e.g., for DI&C without prior NRC approval)
  - Extend to licensing amendment requests that use digital I&C  
(scope and timing of information)
  - Produce corresponding inspection guidance



# MP #4A - Path Forward

- Work with stakeholders to prioritize and create a detailed plan for the complete set of MP #4 activities
- Identify licensing actions to pilot tactical guidance from MP #1-3 and #4A
- Refine the set of tactical guidance
- Pilot tactical guidance to digital modifications without prior NRC approval, or through license amendment requests



# MP #4B - Strategic Modernization

- Address broader modernization issues:
  - Complexity of infrastructure
  - Overly prescriptive nature of infrastructure
  - Regulatory Gaps
  - An efficient means should exist to use alternative standards and pre-existing components that comply with those standards
  - Treatment of DI&C differently from other review areas



# MP #4B - Path Forward

- Perform a broad assessment of the digital I&C regulatory infrastructure
  - Develop clear improvement goals & criteria
  - Comprehensively document the current infrastructure
  - Evaluate the infrastructure against goals & criteria
  - Develop options
  - Prioritize improvements
- Document the consensus vision of the modernized digital I&C regulatory infrastructure
- Execute and refine #4B modernization plans

# Discussion

**QUESTIONS & COMMENTS**